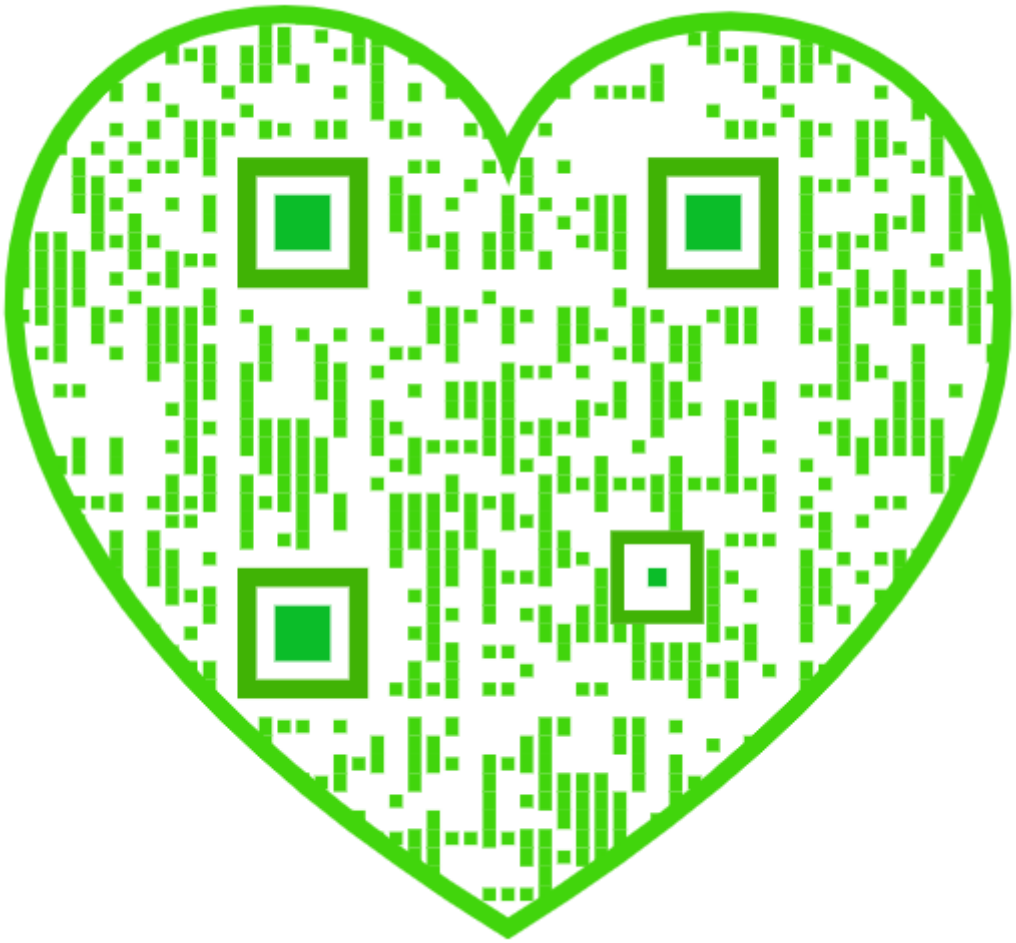
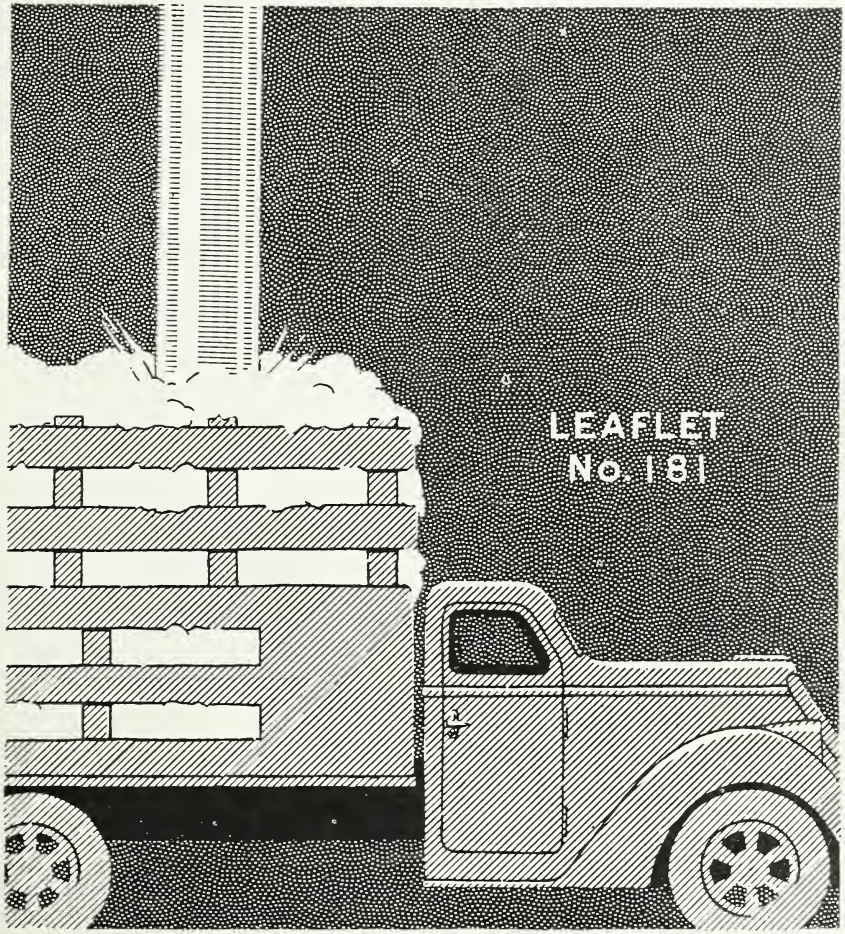


DRYING SEED COTTON



U.S. DEPARTMENT OF AGRICULTURE

DRYING SEED COTTON

By FRANCIS L. GERDES, Cotton Technologist, and WILLIAM J. MARTIN, Associate Cotton Technologist, Bureau of Agricultural Economics, and CHARLES A. BENNETT, Senior Mechanical Engineer, Bureau of Agricultural Engineering

MOISTURE IN SEED COTTON is an important factor affecting the operation of a gin and the quality of the ginned cotton. Lint cotton of inferior preparation frequently comes from ginning seed cotton that has not been properly conditioned, from the early part of the crop that is "green-sappy," or cotton that is damp, dew-laden, or rain-soaked.

Rainfall during the ginning season is only one cause of moisture in cotton. Picking is often started early, before the dew has disappeared, so the first cotton picked each day may be damp or wet. Cotton picked so soon after opening that it has not been dried by sun or wind may be too damp for good ginning. Rank plant growth sometimes prevents green or damp cotton from receiving enough sunlight to dry in the fields. Pickers who are paid on the basis of the gross weight picked are likely to pick many of the greener and heavier locks.

Most farms and many gins are not equipped for drying such cotton, so in many seasons, especially in the Mississippi Valley and the Southeastern States, too much of the crop has been handled by ginners when it was too green, damp, or wet for the best ginning results.

COTTON-DRYING MOVEMENT ADVANCES

To solve this difficulty, the Department of Agriculture began to study methods and equipment for artificially drying seed cotton in 1926. Four years later the Department established cotton-ginning laboratories at Stoneville, Miss., with facilities for testing cotton quality, in order to investigate thoroughly the drying and ginning problems.

The United States Cotton Ginning Laboratories developed and have tested during several years the vertical drier for seed cotton. As soon as the plans for this drier were made public, several commercial ginners built and installed this type and found it satisfactory. Manufacturers of gins then began to make factory-built designs and to develop other types. Every manufacturer of gin machinery and many other manufacturers now make driers for use in gins. The number of driers installed in commerical gins since 1931 has increased rapidly. There were then 15 driers, and they handled 25,000 bales. In 1938 there were 800, handling almost 1,000,000 bales.

The rainy 1937 season demonstrated clearly the value of driers. At least 5 percent of the crop that year was handled by gins with driers. In one State in the Mississippi Valley, where more than 10 percent of the gins used driers, about 15 percent of the crop was dried before being ginned. In another State more than one-fourth of the gins used driers.

Less of the cotton picked in 1938 was damp and wet because the weather and labor supply were good, but the ginners used their driers in handling the early green, damp, and dew-laden pickings and for cleaning late-season, dry-picked cotton, operating at low temperatures (110°–150° F.) to preserve the fiber length.

VERTICAL-TOWER DRIERS ARE DEVELOPED

The original vertical drier developed and tested at the laboratories was a 17-floor, ground-level, double-fan type of installation, designated the Model-A System. It employed these items of equipment: (1) One No. 30, 18-blade cotton-suction fan, (2) one separator, (3) one

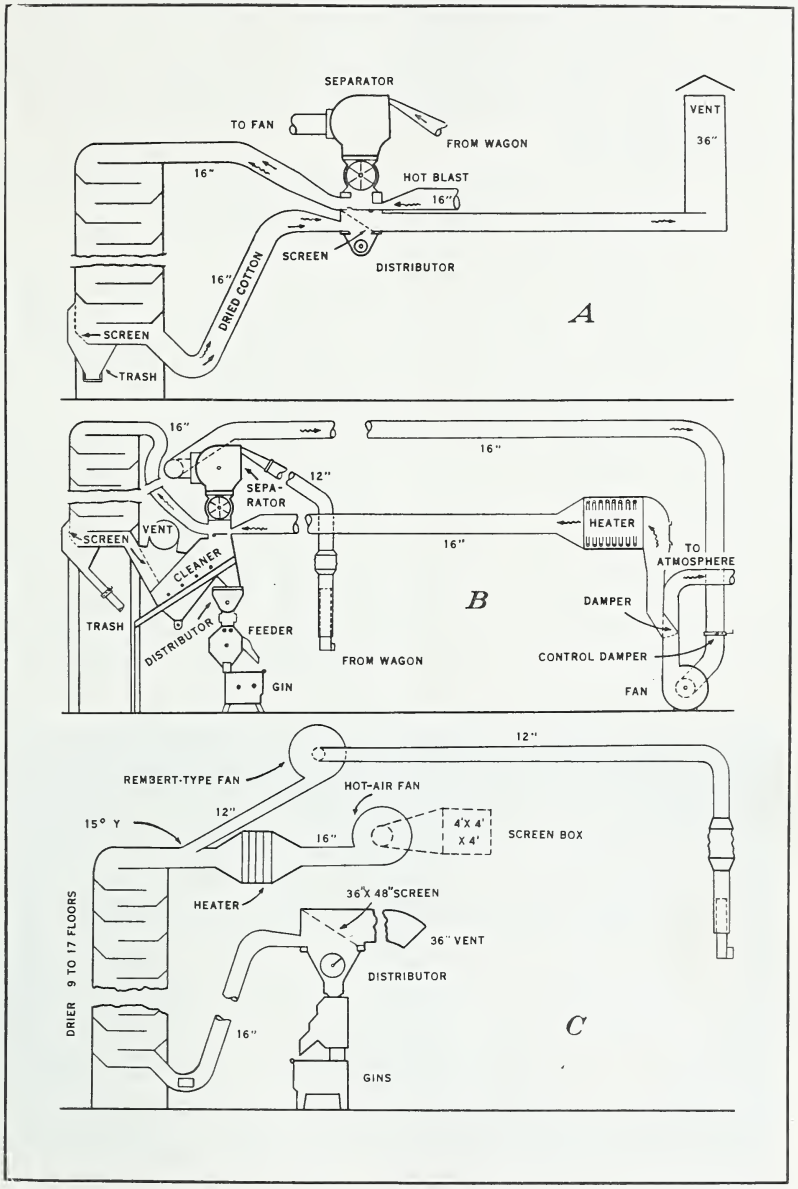


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Figure 1.—Diagram of newer installations of vertical seed-cotton driers: A, Full-length, 17-floor, ground-level pressure system; B, overhead 9-floor drier combined with overhead cleaner, using single-fan method of feeding; C, Rembert-type fan and pressure-tower system.

No. 35, 18-blade hot-blast or drying fan, (4) heater coils, and (5) a 30-horsepower boiler. Other methods of feeding the cotton to the vertical driers have since been developed, and now all are commonly called tower driers.

The first commercial installations of the tower driers were on the ground level; the cotton was lifted from the bottom of the drier by the suction of the overflow telescope. Later, simplified installations were made whereby the drying tower discharged into a cleaner or distributor, so the number of fans or separators could be reduced. A recent ground-level model of the tower, having the same advantages as the overhead installations, has a pressure-discharge system developed by the laboratories (fig. 1, A). It adds only one fan to the usual gin equipment.

In such a system the drier can be placed conveniently because the discharge funnel is made airtight and the dried cotton is blown from the bottom of the drier to either cleaner or distributor. Provision is made for feeding the drier by lifting the regular separator from 12 to 32 inches, inserting a special hot box beneath the vacuum wheel, and blowing heated air into the box to convey the cotton through a hot pipe and into the drying tower. The dried cotton is then blown to a vented screen box placed over the cleaner or distributor. In screw distributors the box is beneath the separator, but in belt distributors it may be placed alongside the separator.

During the 1937 and 1938 seasons there was a call for driers with minimum headroom and maximum suitability for both one-story and two-story gins. This requirement is being met in the standard vertical-drier construction merely by reducing the number of floors and elevating the tower. Several 9- and 11-floor overhead installations have been made of tower driers sometimes connected with cleaners and sometimes connected directly with the distributors, as well as ground-level, pressure-delivery installations. All have given gratifying results, especially where large volumes of drying air were available. A tower cleaner-drier installation is shown in figure 1, B.

A new laboratory development feeds the tower drier with a Rembert fan (fig. 1, C). Cotton is introduced into the hot-air pipe by means of a Y junction of the fan discharge and the hot-air pipe, at the inlet of the drier. It is discharged under pressure into a regular gin separator or a special blow box similar to that used with the pressure system. Thus a suction separator can be dispensed with. These developments reduce the installation and operating costs of the drier.

DRYING TESTS GIVE GOOD RESULTS

In studies to learn the relationships between the moisture content of seed cotton, the resulting quality of ginned lint, and the amount of moisture that may be removed by different methods of artificial drying, 69 American upland cottons, selected from several crops to represent a wide range of seed-cotton characteristics, and the full-length, 17-floor vertical drier were used.

The amount of moisture removed by the 17-floor drier at a temperature of 150° F. increased from about 1 pound per 100 pounds of seed cotton with less than 12-percent moisture to 3 pounds for cotton having 16 percent or more, when exposed 15 seconds. The amount removed from each of these cottons at temperatures up to 250° was only slightly greater than at 150°. Presumably this was because of the relatively short exposure in the drier (15 seconds) and because the

relative humidity of the air heated to the higher temperatures is not appreciably lower than that at 150°. The moisture removed from lint per 100 pounds by drying for 15 seconds at 150° F. ranged from an average of 1.5 pounds for seed cottons below 12 percent in moisture to an average of 4 pounds for those having 16 percent or more. It increased slightly with higher drying temperatures.

Actual differences in the weight of bales due to drying are not permanent, but the loss in weight of the material has been considered when calculating the changes in money value that come from drying seed cotton. The results of a storage test made at Leland, Miss., show that a bale of undried (damp) cotton rapidly lost weight; that a dried bale gained slightly, and that, at the end of 10 weeks, the bales differed in weight by only 4 pounds, as compared with 16 pounds at the beginning of the storage period.

DRYING BENEFITS COTTON GROWERS

Moisture content of seed cotton has a pronounced effect on the smoothness with which the lint can be ginned. Successively lower or poorer preparation is associated with increases in moisture content. Results of ginning damp cotton are more unfavorable with the longer staples and as the seed-roll density is changed from loose to tight.

Average improvements in grade of cotton (or the combined influence of generally smoother preparation and occasionally brighter color and reduced leaf) resulting from artificial drying were greater for the cottons 1⅛ inches and longer than for the shorter staples. Drying at a temperature of 150° F. with the 17-floor drier showed benefits in grade ranging, on an average, from about one grade for either length group having 16 percent or more of moisture, to about one-third of a grade for the longer cottons having 8 to 11.9 percent and the shorter cottons having 12 to 15.9 percent of moisture (fig. 2). Cottons having a moisture content below these respective limits showed little or no net improvement in quality as a result of drying.

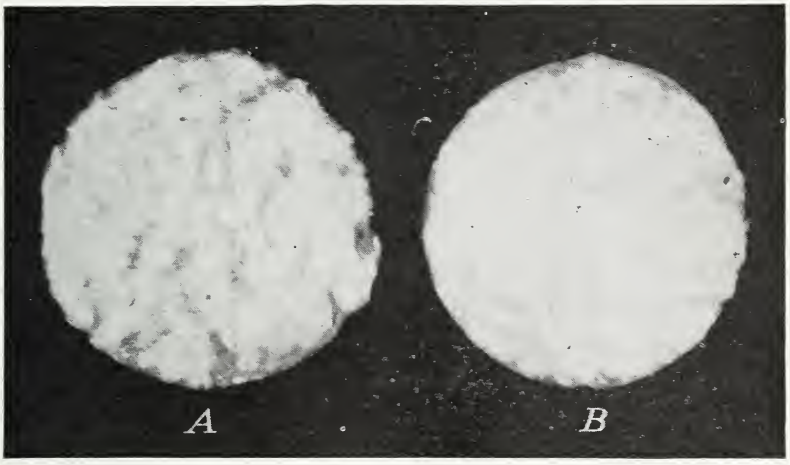

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Figure 2.—Ginned-lint samples: A, result from ginning portions of 1 3/16-inch cotton in a green and wet condition; B, result from ginning another portion after the cotton had been dried in a vertical drier.

With late-season, trashy, dry cottons, the ginners find that driers are as good as most cleaners in removing trash and improving the grade. But they use either unheated air or air heated at a very low temperature to keep from shortening the staple.

The percentage germination of seed taken from portions of seed cotton that had been dried at test temperatures was not reduced by drying but was slightly higher and apparently the milling qualities of the ginned seed are helped by drying the seed cotton.

Even in the fields the advantages of artificial drying are felt. The fact that the cotton will be dried permits picking during moderately damp weather and from fields with heavy foliage relatively soon. (The cotton must not be picked when wringing wet.) Some cotton can be handled that heretofore has been left unpicked or on the ground.

WATCH THE TEMPERATURES

Fiber strength was not weakened by drying the seed cottons at temperatures up to 200° F., but there was a slight weakening of the fibers when the material was dried twice at 250°. Staple length, on an average, was preserved when the cotton was dried at 150° F., but, in general, higher drying temperatures resulted in ginned lint with slightly shorter staple length. In many cases, drying temperatures above 200° were associated with shortening of staple to an extent of one thirty-second to one-sixteenth of an inch.

For the usual run of damp or wet cotton, the drying temperatures should not exceed 160° F. Preferably they should not exceed 150°. A slightly higher temperature can be used with very wet cotton, but under no circumstances should it exceed 200°. High temperature "bakes" the cotton, weakens the fiber strength, and injures the spinning quality. It is better to pass wet cotton twice through a drier operated at a moderate temperature (150° F.) than once at a temperature above 200°. It slows down the ginning, but many ginners do it to preserve the staple length.

EFFECTS HAVE MONEY VALUE

Money benefits per bale from drying the green, damp, or wet cottons at 150° F. ranged, on an average, from 70 cents for the short-staple cottons, to $2.50 for the long staples. The average grade and staple premiums and discounts at Memphis, Tenn., for the 1932–33 season were used as a basis for these calculations, and the lint turn-out differences were taken into account. Even with the comparatively dry cottons of long-staple length, the bale-value betterments averaged $2; but the short-staple cottons that were dry enough to be ginned smoothly without going through the drier were reduced in value by drying.

The drier offers satisfactory ginning volume and maximum safety to both the product and the ginning plant. Results thus far compare favorably with those generally attributed to sun-drying and storing. The addition of a drier to gin equipment appears to be one of the most practical and economical means for drying seed cotton. The operating cost of drying a bale of seed cotton generally ranges from 5 to 25 cents. It seldom exceeds 30 cents.

MARKET CHANNELS REFLECT IMPROVEMENTS

Driers in commercial gins are reducing the number of wet and oily bales in the channels of trade. Wet seed cotton having as much as 16-percent moisture content, or 19-percent regain, when properly dried mechanically before being ginned, will yield lint having no more than 7.8-percent moisture content, or 8.5-percent regain. This is acceptable in foreign markets. The drying process helps to prevent the pouring of kerosene into the roll boxes (to prevent chokages) which usually means oil-stained bales.

DRIERS HAVE SOME LIMITATIONS

Artificial drying of green, damp, or wet seed cotton makes possible a continuous operation of the gin without loss of time from chokages or break-downs and allows a reasonable increase in ginning capacity with no loss of quality to the product and affords a slight reduction in power requirements. But, growers and ginners should understand that there are definite limitations to what driers can do even when in good condition and properly operated. They are not designed for efficient drying of extremely wet cotton.

Ginners should take certain precautions. They should clean the heater screens daily to prevent reductions of the quantity of air that is blown through the driers and irregularities in air volume and temperature. They should feed the drier no faster than necessary to supply enough cotton for loose-roll ginning and keep from having a big overflow. They should inspect each incoming load of seed cotton and adjust the drying-air temperature and feeding rate to the requirements of the load so that the best grades can be had without harming the staple length.

FACTORY-BUILT DRIERS ARE AVAILABLE

Factory-built cotton driers are available in the form of (1) rectangular- and cylindrical-tower types, (2) single- and multiple-conveyor cleaner types, (3) combined tower and overhead cross-drum cleaner-driers, (4) extractor-feeder system, (5) paddle-wheel-drum cleaner-drier, and (6) multiple-drum axial-flow air-line cleaner process. (These driers are illustrated and described in Farmers' Bulletin No. 1802, entitled "Modernizing Cotton Gins.")

SMALL GINS CAN DRY ECONOMICALLY

Several forms of inexpensive cleaner-driers that involve the introduction of heated air into cleaners have now been developed. One is the type devised by the Department of Agriculture in which hot air is introduced into the suction line of an air-line cleaner along with the seed cotton from the wagon. A split suction on the inlet side of the cleaner brings together the damp cotton and conveying air from one pipe and the heated air from the other pipe (fig. 3). Thus, the air-line cleaner becomes the drying chamber, and its drying effect may be supplemented if distribution is accomplished pneumatically.

The installation cost of an air-line drying system may be held between $500 and $700 if the gin already has a cleaner and has a suction fan of a capacity adequate to provide both hot air and the suction for conveying the cotton. Even if a pneumatic system does not

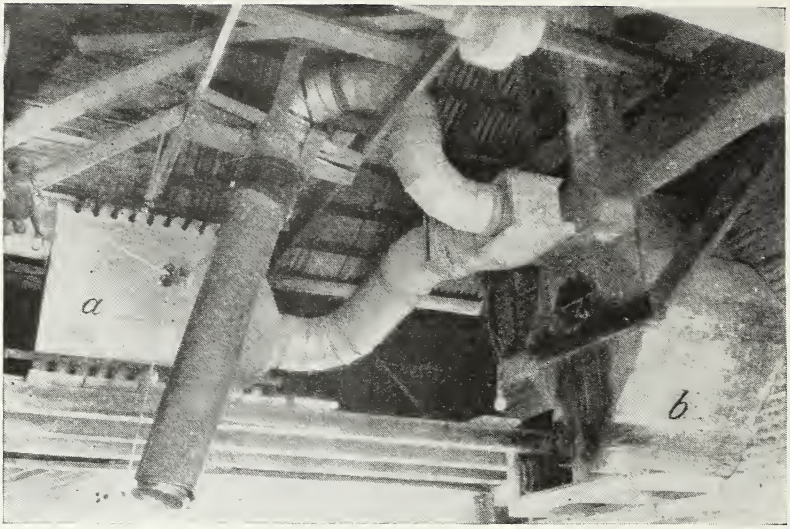

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Figure 3.—Commercial installation of the Government-designed air-line drier: a, Heater coils and split-suction arrangement; b, drying chamber. This is covered by a public-service patent so any person can build one without paying royalty.

have a cleaner, introducing hot air into the suction line provides fairly effective drying in the pneumatic elevators.

SEVERAL SOURCES OF HEAT CAN BE USED

There are at least three sources of heat for cotton driers: (1) Steam; (2) engine-cooling water and exhaust; and (3) furnace. Combinations of these are often practicable. For the steam-heating systems in which pipe coils or fin-type heaters are supplied with steam for heating the drying air, at least 7½ boiler horsepower should be provided per gin stand. This can be live steam furnished by a small boiler or by an oversized boiler that supplies steam for the main power unit, or the steam may be supplied in part by the exhaust of the engine in such steam-powered gins.

If the gin is equipped with an internal-combustion engine, the hot air may be obtained by using the waste heat in the engine exhaust and cooling water. The heat in the cooling water is extracted by drawing or blowing the drying air through a honeycomb or fin-type radiator and then blowing it through an exhaust-heat extractor and furnace. Except in gins having oversized engines, the use of the furnace is usually desirable to add varying quantities of heat to that obtained from the cooling water and the exhaust gases. A boiler of 10 to 15 horsepower supplying steam for heaters of one-half the usual heating surface can be used to provide the heat that this furnace ordinarily supplies in addition to that extracted from the engine.

Some factory-built drier installations use furnaces to supply all the heat for drying. Observations of installations of inexpensive cast-iron furnaces (capacity 200,000 B. t. u. per hour with fan) indicate that enough drying heat can usually be obtained with the driers having a short exposure and handling 3,500 or less cubic feet of air per minute or feeding not more than three gin stands.

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